University of Cambridge

SOLAR PHYSICS OBSERVATORY

SECOND ANNUAL REPORT OF THE DIRECTOR OF THE SOLAR PHYSICS OBSERVATORY TO THE SOLAR PHYSICS COMMITTEE

1914 APRIL 1—1915 MARCH 31

Second Annual Report of the Director of the Solar Physics Observatory

7 *June* 1915.

The Vice-Chancellor begs leave to publish to the Senate the following Report which the Solar Physics Committee have received from the Director of the Solar Physics Observatory:

The Report here presented relates to the year 1914 April 1 to 1915 March 31 and deals with work which has been carried out under disadvantageous conditions arising from the war.

The Assistant Director, who was one of the observers taking part in the eclipse expedition to the Crimea, referred to in a later paragraph, was recalled ten days before the eclipse took place to rejoin the Officers Training Corps at Cambridge; he has received a commission as Captain in command of the Signals Company of the 20th Division of the new Expeditionary Force, and has been in training at Aldershot and Salisbury Plain. The two Junior Observers have been drilling with the Officers Training Corps, but have been able to devote half time to duty at the Observatory. Much of the work of completing the installation of the instruments has had to be laid aside or replaced by temporary expedients on account of the occupation of instrument makers with military supplies.

The following paragraphs deal with the various branches of work in progress.

A. *Stellar Work.*

Investigations of Stellar Spectra. The Cambridge spectrograms of Nova Geminorum No. 2 have been completely measured and discussed by Mr F. J. M. Stratton. Publication of the results obtained was postponed, as fresh material filling up most of the gaps in the Cambridge series was kindly offered by Dr Schlesinger, Director of the Allegheny Observatory. The few dates left unrepresented in the Cambridge and Allegheny series were filled by spectrograms kindly sent for study by Dr Küstner, Director of the Bonn Observatory. The measures and most of the reductions of this fresh material have been made, but the eclipse work and the war have combined to cause a further postponement in publication.

Considerable progress has been made by Mr Baxandall in the work of assigning chemical origins of lines in stellar spectra, in preparation for an atlas of typical stellar spectra.

A paper by Mr Baxandall on the enhanced lines of manganese in the spectrum of α Andromedæ was communicated to the Royal Astronomical Society (*M.N.*, vol. lxxiv. 250). This star and μ Leporis (mag. 3·5) seem to be the only recorded instances of this peculiarity.

The green region of the spectra of several of the brighter stars (α Cygni, α Canis Minoris, α Persei, α Canis Majoris) has been studied by Mr Baxandall in photographs obtained by Professor Newall in 1905 with the four-prism spectrograph attached to the 25-inch telescope. The results of measurements and comparison of various typical spectra are being prepared for publication.

The Newall Telescope. Observational work with the 25-inch equatorial has been in abeyance.

Huggins Instruments. The new spectrograph has been adjusted and is nearly ready for regular work. The correcting lens for adapting the colour correction of the Huggins 15-inch refractor to spectrographic work over a wide range of wave-lengths has been very satisfactorily adjusted. A new guiding telescope has been constructed in the workshop and fitted to the instrument, which now needs only the temperature control and the definitive comparison apparatus based on experience gained in the use of the arrangement extemporised for experimental trial. Photographs of the spectra of α Lyræ, α Cygni, β Leonis, α Canum Venaticorum, ϵ Ursæ Majoris and other bright stars have been obtained by Mr Rolston during the process of adjustment.

The 3-foot Reflector. The erection of the heavy parts of the 3-foot reflector in the new dome built for it was successfully accomplished in March. The alterations made for improving the counterpoising of the instrument are found to be quite satisfactory. A plan for the staging required for manipulating the instrument in all positions was worked out, but the pressure of preparations for the eclipse made it necessary to defer the completion of the work.

B. *Solar Work.*

Spectroheliograph. The instrument giving the $2\frac{1}{4}$ inch image of the sun has been in use throughout the year in the charge of Mr Butler, assisted by Mr Moss; and records have been obtained whenever the weather permitted. Photographs of the sun's disc in K_{232} light showing the distribution of calcium flocculi have been obtained on 143 days, and photographs of the sun's limb in the same light showing the distribution of prominences on 110 days. Both series give evidence of continued increase of solar activity; at times the zones of flocculi, in relatively high latitudes on either side of the solar equator, have been active from limb to limb.

Some minor difficulties having been experienced owing to the irregular flexure of the wooden mounting of the spectroheliograph, a rigid metal framework has been substituted and improved means of adjustment of the optical parts have been provided.

Electric lamp radiators have been installed in the siderostat hut and in the spectroheliograph building, in order to diminish the trouble arising from the deposition of dew in the late autumn and early spring months.

The plane mirrors (18 inch and 6 inch) were resilvered on 1915 March 5, and the photovisual lenses of the spectroheliograph were separated and cleaned.

The Director of the Kodaikánal Observatory has forwarded 329 spectroheliograms, showing the solar disc in calcium light, for the period 1914 January 1 to 1915 December 31. Of the gaps in the Kodaikánal record there are Cambridge records for 15 days, so that solar records of calcium flocculi are available for 344 days in 1914.

Photoheliograms. Daily photographs taken with the Dallmeyer photoheliograph at Dehra Dûn have been received. The negatives are stored at the Science Museum, South Kensington; the positive prints, also received from Dehra Dûn, are mounted at Cambridge for comparison with the spectroheliograms, which are enlarged photographically to the same size. Between August and March, 608 enlargements of spectroheliograms have been made, and the considerable arrears are thus being quickly worked off.

Study of Sun-spot Records. Considerable progress has been made by Mr Moss in the study of the areas and life history of sun-spots from the Greenwich records 1889–1901. The tabulation of heliocentric positions of sun-spot groups during the two cycles 1889–1901 and 1902–1912 has been completed and charts have been made.

M'Clean Solar Instruments. In making tests of the new 12-inch object-glass made by Messrs T. Cooke & Sons, signs of zonal errors were traced to the two 16-inch plane mirrors of the cœlostat. The mirrors have been refigured by Messrs Cooke and were remounted in position in October 1914. Under the Hartmann test the combination is now found to be as near perfection as can be achieved. The instruments have been used by the Director in observations of sun-spot spectra, and successful photographs of sun-spot lines in the spectral region between λ 5300 and λ 5500 have been obtained. In preparation for the measurement and discussion of these and future photographs of spot-spectra, Mr Baxandall has reviewed the chemical origins of the lines in this region of the solar spectrum, and has found probable origins for about 150 lines for which Rowland gave no identification.

Mr J. B. Hubrecht has completed for publication a memoir on his investigations of the Solar rotation from spectrographic observations made at Cambridge with the M'Clean Solar Instruments in 1911. It is now being printed, and will be published as Part I of Volume III of the Annals of the Solar Physics Observatory.

Solar Eclipse 1914, *August* 20–21. Preparations for the observations planned to be made near Theodosia, Crimea, occupied considerable time in the spring and early summer of 1914, especially in the mounting and adjustment of the 6-inch Rowland concave grating for observations of the spectra of the Sun's limb and of the corona. The observers, including the Director, Mr Stratton and Mr C. P. Butler, accompanied by Mrs Newall, and by Mr R. Rossi who had volunteered assistance in the preparations and observations, travelled out to the Crimea via Trieste, the Mediterranean, and the Black Sea to Theodosia. They arrived at their destination on July 25, four days before the posting of orders of mobilisation of the Russian troops, and in the distracting conditions they received much kind assistance in making the necessary preparations for the observations, in particular from Monsieur Beljawsky, the astronomer from the Simeis Observatory, and Monsieur Sarandinaki, the engineer of the port of Theodosia. Unfortunately observations were completely foiled by cloud. Mr Stratton was recalled to join the Officers Training Corps, and left Theodosia on August 11, ten days before the eclipse. Mr Rossi returned to Italy after the eclipse, and the rest of the party reached England via Petrograd and Norway on September 17. The instruments are still stored at Odessa. A brief report on the expedition has been communicated to the Royal Astronomical Society (*Monthly Notices*, lxxv. 134).

C. *Meteorological Physics.*

Investigations in Atmospheric Electricity. Mr C. T. R. Wilson has developed apparatus for studying quantitatively some of the more important phenomena of atmospheric electricity. In the method worked out, one and the same apparatus is sufficient to measure (i) the charge on the surface of the ground, or in other words the vertical electric field or potential gradient at the surface; and (ii) its variations, including the almost instantaneous changes of field which result from lightning discharges; and (iii) the current from the atmosphere into the ground, whether due to conduction by the movement of ions under the action of the field or to convection by falling raindrops. Mr Wilson has succeeded in measuring the instantaneous changes of field resulting from distant lightning flashes, and in gaining information bearing on the quantity of electricity discharged in a flash.

The study of the tracks of ionising particles in gases by the condensation method, and of the processes of radioactive phenomena which they so clearly visualize, has also been continued by Mr Wilson with improved apparatus. Stereoscopic photographs of the tracks have now been obtained and the interpretation of the records has thereby been greatly facilitated.

D. *Work in the Laboratory.*

The detention at Odessa of the instruments taken to the Crimea for eclipse observations has impeded progress in experimental work in the laboratory.

The work done in preparation of the 6-in. Rowland concave grating for use as an objective spectrograph during the eclipse has served also for determining the best arrangement for use in the laboratory, when the grating and its camera are returned from Odessa. Meanwhile the 6-inch plane grating ruled by Dr Anderson with 15,000 lines to the inch on a ruled area $5\frac{1}{4}$ inches by $3\frac{3}{8}$ inches has been mounted with the requisite adjustments, in conjunction with an auto-collimating lens of Cooke's photovisual form, of aperture 6 inches and of focal length $20\frac{1}{4}$ feet. The Littrow spectrograph thus formed has been temporarily mounted on the north-south rail of the concave grating mounting. The spectrum of the first order has a dispersion of 1 millimetre to $2^{\lambda}\cdot70$ at $\lambda\,6700$, on a plate of dimensions 12 inches by 2 inches.

With this instrument, an investigation has been made of the conditions of occurrence of a line near $\lambda\,6708$ in the spectra of iron and lithium. Some preliminary experiments have been made in reference to hydrocarbon flutings, which are of interest in connexion with the solar and stellar spectra. Fairly conclusive evidence has been found that these flutings are well represented in the solar spectrum and in certain types of stellar spectra. Before the definite results of the enquiry are published, successful photographs of the structure of the flutings with large dispersion are necessary for detailed comparison with the solar lines.

Mr Rossi has published the results of his work on the widening of the lines in the spark spectrum of hydrogen (*Astroph. Jour.*, xl. 232). In studying the displacements of lines in spectra of the Sun's limb, he has measured and discussed a considerable number of photographs of the region of the spectrum about wave-length 6300 taken by Professor Newall in 1908. The photographs give material for comparison of the displacements (at the east, west, north, and south limbs, and at the centre of the disc) of solar lines relative to oxygen lines of telluric origin.

E. *Miscellaneous.*

Library and Lectures. Considerable progress has been made in the arrangement, binding, and cataloguing of the books in the Library, in the charge of Mr Rolston.

A number of valuable publications have been received in the course of the year, and the Director desires to record his grateful acknowledgments to the donors. A list is appended.

It is with deep regret that the death of Lady Huggins is announced. The Director desires to place on record her constant interest in the welfare of the institution and in the advance of the Science of Astrophysics; her munificent gifts of physical instruments and appliances in connexion with the Huggins telescopes are of high value to the Observatory.

Lectures have been given by Professor Newall on solar research, and by Mr Stratton on stellar physics.

The Director desires to record his appreciation of the hearty cooperation of the staff throughout the year.

H. F. NEWALL.

Solar Physics Observatory,
1915 *May* 29.

The Director gratefully acknowledges the receipt of the following works, which have been presented to the Library of the Solar Physics Observatory:

ASTRONOMY.

	DONORS.
Allegheny Observatory, Pa. Publications. Vol. I. Nos. 1, 2, 14, 21; Vol. II. Nos. 1, 12—18; Vol. III. Nos. 1—18. Lancaster, Pa., 1907—1915. 4to.	The Observatory.
Antwerp, Société d'Astronomie. Gazette Astronomique. Nos. 78—81. Anvers, 1914. 4to.	The Society.
Antwerp, Société d'Astronomie. Mémoires No. 1. Anvers, 1914. 8vo.	,,
Astrophysical Journal. Vol. XXXIX. 3—XLI. 1. Chicago, 1914–15. 8vo.	Prof. Newall.
Brera, Reale Osservatorio di Brera in Milano. Pubblicazioni. Nos. LI. and LII. Milan, 1914, 1915. 4to.	The Observatory.
Cape of Good Hope, Royal Observatory. Report of H.M. Astronomer, 1913. London, 1914. Fcp.	,,
Copenhagen, Observatorium. Publikationer og mindre Meddelelser. Nos. 19, 20. Kobenhavn, 1914, 1915. 4to.	,,
Copenhagen, Universitets Astronomiske Observatorium. Ephemeriden-Zirkular der Astronomische Nachrichten. (Temporary publication of the Kiel Centralstelle ephemerides, etc.) Nos. 470—479. Kiel, 1915. 4to.	,,
Greenwich, Royal Observatory. Annual Report of Astronomer Royal, 1913–14. London, 1914. 4to.	,,
Greenwich, Royal Observatory. Photo-heliographic Results, 1905–12 inclusive, 5 copies of each. London, 1906–14. 4to.	,,
Harvard College Observatory. Annals. Vols. LXIII. Part 2; LXIX. Part 2; LXXI. Part 3; LXXIII. Part 1; LXXVI. Parts 2 and 3. Cambridge, Mass., 1913–14. 4to.	,,
Harvard College Observatory. Bulletins Nos. 544—568. Cambridge, Mass., 1914. 4to.	,,
Harvard College Observatory. Circulars Nos. 183, 184 and 187. Cambridge, Mass., 1914–15. 4to.	,,
Harvard College Observatory. Report, No. 69. Cambridge, Mass., 1915. 8vo.	,,
Heidelberg, Akademie der Wissenschaften. Sitzungsberichte. 1914. Part 6. Heidelberg, 1914. 8vo.	Prof. Max Wolf.
Hyderabad, Nizamiah Observatory. Annual Reports, 1913–14. Hyderabad, 1914. 8vo.	The Observatory.
Johannesburg, Union Observatory. Circulars Nos. 17—23. Johannesburg, 1914–15. 4to.	,,
Kodaikanal, Observatory. Annual Report, 1913. Madras, 1914. Fcp.	,,
Kodaikanal, Observatory. Bulletins Nos. 37—44. Madras, 1914. 4to.	,,
Leander McCormick Observatory, University of Virginia. Publications. Vol. II. Parts 2—4. Charlottesville, Va, 1913–14. 8vo.	,,
Leeds, Astronomical Society. Journal and Transactions, 1912. Leeds, 1913. 8vo.	The Society.
Lick Observatory. Bulletins Nos. 253—268. Berkeley, Cal., 1914–15. 4to.	The Observatory.
Lick Observatory. Publications. Vol. XI. Berkeley, Cal., 1913. 4to.	,,
London, Royal Astronomical Society. Memoirs. Vol. LX. Part 4. London, 1914. 4to.	The Society.
London, Royal Astronomical Society. Monthly Notices, Vol. LXXIV. 5—Vol. LXXV. 4. London, 1914–15. 8vo.	,,
Lowell Observatory, Arizona. Bulletins Nos. 59—66. Flagstaff, 1914–15. 4to.	The Observatory.
Madrid, Observatorio. Anuario, 1915. Madrid, 1914. 8vo.	,,

	Donors.
Ottawa, Dominion Observatory. Publications. Vol. I. Nos. 6—13. Ottawa, 1913–14. 4to.	The Observatory.
Ottawa, Dominion Observatory. Report of Chief Astronomer, 1910. Vol. III. and Vol. III. (Maps.) Ottawa, 1913. 8vo.	,,
Oxford, University Observatory. Astrographic Catalogue. Vol. VIII. Part I. Oxford, 1913. 8vo.	,,
Oxford, University Observatory. Collated List of Lunar Formations compiled for the Lunar Nomenclature Committee of the International Association of Academies by Mary A. Blagg. Oxford, 1913. 8vo.	,,
Oxford, University Observatory. Publications (reprinted papers). Nos. 189, 192—197, 199—204, 213—215, 217—225 and 228. 1911–13. 8vo.	,,
Oxford, University Observatory. Reports of Savilian Professor. Nos. 37 and 38. Oxford, 1913. 4to.	,,
Oxford, University Observatory. Tables for Facilitating the Use of Harmonic Analysis, by Prof. H. H. Turner. Oxford, 1913. 8vo.	,,
Paris, Société astronomique de France. Observations et Travaux. Nos. I. and II. Paris, 1912, 1914. 8vo.	The Society.
Pulkowo, der Nikolai-Hauptsternwarte. Mitteilungen. Vol. VI. 1, No. 61. Pulkowo, 1914. 4to.	The Observatory.
Sidmouth, The Hill Observatory. Bulletin. Vol. I. Nos. 1 and 2. Sidmouth, 1914–15. 4to.	,,
South Kensington, Imperial College of Science and Technology, Astrophysical Department. Reprinted Papers, various. London, 1914–15. 8vo.	The College.
Tortosa. Observatorio del Ebro, Roquetas, Spain. Boletin Mensual. Vol. II. 9; Vol. III. 7—12; Vol. IV.; Vol. V. 1—5. Tortosa, 1912–14. 4to.	The Observatory.
Tortosa. Observatorio del Ebro, Roquetas, Spain. Memorias. No. 5. Tortosa, 1914. 4to.	,,
Uccle. Observatoire royal de Belgique. Les Progrès Récents de l'Astronomie, 1912. Uccle, 1914. 8vo.	,,
Washington, United States Naval Observatory. American Ephemeris, 1916. Washington, 1914. 8vo.	,,
Washington, United States Naval Observatory. Annual Report 1914. Washington, 1914. 8vo.	,,
Washington, United States Naval Observatory. Publications. Vol. VIII. Series 2. Washington, 1914. 4to.	,,
Zürich, Sternwarte des eidg. Polytechnikums. Astronomische Mitteilungen. No. 105. Zürich, 1915. 8vo.	,,

Meteorology.

Australia, Commonwealth Bureau of Meteorology. Monthly Weather Report. Vol. II. 4—12; Vol. III. 1—5. Sydney, 1913–14. 4to.	The Bureau.
Australia, Commonwealth Bureau of Meteorology. Rainfall Maps, 1913. Sydney, 1914.	,,
Australia, Department of Lands and Surveys, Western Australia. Report of Surveyor General 1914. Perth, 1914. Fcp.	The Department.
Batavia, Royal Magnetical and Meteorological Observatory. Observations made at the Royal Magnetical and Meteorological Observatory. Vol. XXXIV. Batavia, 1911. Fol.	The Observatory.
Batavia, Koninklijk Magnetisch en Meteorologisch Observatorium. Regenwaarnemingen in Nederlandsch-Indië, 1912. Deel II. Uitkomsten. Batavia, 1913. 8vo.	,,

	Donors.
Brera, R. Osservatorio astronomico di Brera in Milano. Osservazioni Meteorologiche e Geofisiche. Vol. v. Milano, 1914. 4to.	The Observatory.
Canada, Dominion Meteorological Service. Monthly Weather Review. Vol. xxxviii. Nos. 2—12. Toronto, 1914. 4to.	Department of Marine and Fisheries.
Canada, Meteorological Service. Reports, 1911. Vols. i. and ii. Ottawa, 1914. 4to.	,,
Christiania, Norwege Meteorologische Instituts Aarsberetning, 1912–13. Kristiania, 1913. 8vo.	The Institute.
Christiania, Norwege Meteorologische Instituts Jahrbuch, 1913. Kristiania, 1914. Fol.	,,
Christiania, Norwege Meteorologische Instituts Oversigt over luftens temperatur og nedboren i Norge, 1912, 1913. Kristiania, 1913, 1914. 8vo.	,,
Edinburgh, Scottish Meteorological Society. Journal. Vol. xvi. No. 31. 1913. Edinburgh, 1914. 8vo.	The Society.
Holland, Institut météorologique royal. Caractère Magnétique de chaque jour des mois, 1914, 1, 2 and 3. de Bilt, 1915. Fol.	The Institute.
India, Meteorological Department. Memoirs, Vol. xxi. Parts 8 and 9; xxii. Parts 1 and 2, Corrigenda, Part 3; xix. Parts 3 and 4. Calcutta, 1914. 4to.	The Indian Government.
India, Meteorological Department. Memoranda on Monsoon Conditions in India. Simla, 1914–15. Fcp.	,,
India, Meteorological Department. Monthly Weather Review 1913, December; 1914, January—September. Calcutta, 1914–15. 4to.	,,
India, Meteorological Department. Statements of Rainfall. Simla, 1914–15. Fcp.	,,
London, Meteorological Office. Hourly Values from Autographic Records. Geophysical Section, 1912. London, 1914. 4to.	The Meteorological Committee.
London, Meteorological Office. Hourly Values from Autographic Records. Meteorological Section, 1912. London, 1913. 4to.	,,
London, Meteorological Office. Reports of Meetings of the International Meteorological Committee. Tenth. Rome, 1913. London, 1914. 8vo.	,,
Mauritius, Royal Alfred Observatory. Annual Report, 1912. Mauritius. 1913. Fcp.	The Observatory.
Mauritius, Royal Alfred Observatory. Miscellaneous Publications, No. 4. Mauritius, 1913. Fcp.	,,
Mauritius, Royal Alfred Observatory. Results of the Magnetical and Meteorological Observations, 1907 and 1909. Mauritius, 1913. 4to.	,,
Modena, R. Osservatorio Geofisico. Osservazioni Meteorologiche, No. 28, 1914. Modena, 1914. 4to.	,,
Moncalieri, Osservatorio del Real Collegio Carlo Alberto. Bollettino Meteorologico e Geodinamico, Osservazioni Meteorologiche, 1913, December; 1914, January—April. Moncalieri, 1914. 8vo.	,,
Moncalieri, Osservatorio del Real Collegio Carlo Alberto. Bollettino Meteorologico e Geodinamico, Osservazioni Sismiche, 1913, 13—16; 1914, 1—2. Moncalieri, 1914. 8vo.	,,
New Zealand, Government Meteorological Observatory. Meteorological Tables from the New Zealand Gazette, 1914, April—November; 1915, January; 1913, Yearly Summary. Wellington, 1914, 1915. Fcp.	,,
Oxford, Radcliffe Observatory. Results of Meteorological Observations. Vol. li. Part 4, 1914. Oxford, 1915. 8vo.	,,
San Fernando, Instituto y Observatorio de Marina. Anales, 1913, Sección 2 a. San Fernando, 1914. Fol.	The Institute.
Santiago de Chile, Instituto central Meteorológico y Geofísico. Publicaciones, Nos. 4—9. Santiago de Chile, 1913–14. Fol.	,,

	Donors.
Southport, Fernley Observatory. Report and Results of Observations, 1913. Southport, 1914. 8vo.	The Observatory.
Stonyhurst College Observatory. Results of Meteorological, Magnetical and Seismological Observations, 1914. Blackburn, 1915. 8vo.	,,
Strassburg, Commission interuationale pour l'Aérostation scientifique. Publications, 1912, Nos. 3—6. Strassburg, 1914. 4to.	The Commission.
Utrecht, Koninklijk Nederlandsch Meteorologisch Institut. Ergebnisse Aerologischer Beobachtungen, 1909–12, Part I. Utrecht, 1913. 8vo.	The Institute.
Utrecht, Koninklijk Nederlandsch Meteorologisch Institut. Jaarboek: (A) Meteorologie, (B) Aard-magnetisme, 1912, Nos. 97 and 98. Utrecht, 1913. 4to.	,,
Washington, Carnegie Institution. Department of Terrestrial Magnetism. Annual Report of the Director, 1914. Washington, 1915. 8vo.	The Institution.

Together with numerous pamphlets and reprints of papers presented by the authors.

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